

OSTEOPLASTIC RESECTION OF THE COSTAL
ARCH, FOLLOWED BY RESECTION OF LES-
SER CURVATURE OF STOMACH AND ŒSOPHA-
GUS, AND ŒSOPHAGOSTOMY.*

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OWING to their extreme inaccessibility, largely due to the unyielding character of the chest wall, malignant tumors of the cardia and lower end of the œsophagus have until quite recently been considered a *noli me tangere*. True, these lesions are fortunately not common. Osler and McCrae in a series of 150 consecutive cases of carcinoma of the stomach found only two such cases.

Micheli, in a report to the Tenth Italian Congress of Surgeons in 1895, seems to have been the first to have worked out a definite operation for exposing the lower end of the œsophagus. He proposed and carried out on the cadaver, but never on the living subject, a thoracoplasty whereby a flap was raised, including the lower end of the chest wall, together with the diaphragm and parietal peritoneum. The operation would seem to be a very serious one, with considerable danger of injuring the pleura. Gottstein, in 1901, referred to two operations done by Mikulicz. In the first case he carried out a procedure similar to Micheli's. In his later case he made a median abdominal incision and several transverse incisions through which he divided the seventh, eighth and ninth ribs. Both of these patients of Mikulicz died from the effects of the operation, as in each case an extensive resection of the stomach was done.

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Kelling, in 1901, after referring to an operation suggested by Lannelongue which he considers too mutilating (especially as we cannot at the start be sure that we will be able to do a radical operation), suggests a special posture for operations at the vault of the diaphragm. The head and trunk are to be on a table slightly elevated and the lower extremities hang vertically down over the end of the table with the feet resting on a pillow on the floor. This posture is similar to that used by anatomists in dissections of the diaphragm. A strap holds the trunk of the patient on the table; the leg holders are turned down and the patient is fastened with the spine bent in the dorsal and lumbar region. An incision is made in the median line and a second incision at a right angle extending to the tip of the twelfth rib. One of the objections to the posture is the difficulty in keeping the intestines within the abdomen, and a further objection is the difficulty in maintaining asepsis. The posture was not a practical one, and this led Kelling to modify it in an article published in 1904. In this article he recommends a pseudo hip-rest which is applied to the region of the diaphragm or liver. We have for several years been using a table at Mount Sinai Hospital which enables us by turning a handle to break the table into two inclined planes. In this way a deeply-seated gall-bladder or common duct or stomach, is made much more accessible. Dr. Howard Lilienthal devised a similar portable table in 1903.

Marwedel, in 1903, described an incision for osteoplastic resection of the chest. He claimed for his incision that it was less complicated and less dangerous than those referred to above. He makes only one abdominal incision. It begins at the ensiform and runs parallel to the free border of the ribs and 3 cm. from it, and extends to about the tenth rib. The seventh costal cartilage is divided close to the sternum. By blunt dissection the seventh, eighth and ninth ribs are laid free and divided close to the junction of the cartilaginous and bony portions. In this way a freely movable flap is obtained, and the exposure is surprisingly good. If necessary the sixth costal cartilage could also be divided. Beginning with the

seventh rib care must be taken not to injure the pleura. Towards the median line it is only necessary to divide the seventh rib, as the lower ribs do not reach the sternum. Marwedel performed the operation in a case of stenosis and spindle-shaped distention of the œsophagus due to cardio-spasm. At the operation he found the stenosis above the diaphragm and was unable to do the plastic operation which he had planned.

Asthoewer, writing in 1903, referred to a case which he had operated on in 1894 through an incision similar to that described by Marwedel. The first incision was exploratory, at the outer border of the left rectus; this was enlarged upward to the free border. A second incision was made at right angles to the first, reaching to the tip of the eleventh rib, and a third incision parallel to the first extended from the eleventh rib upwards. The eighth, ninth and tenth ribs were divided as well as the costal cartilages of the seventh and eighth ribs close to the sternum. Through this incision a multiple fibroma of the spleen weighing seven pounds was removed. The patient died in twenty-four hours. In another case, operated on in 1902, Asthoewer made a somewhat similar incision in an attempt to remove a sarcoma originating in the ribs on the left side. The tumor turned out to be inoperable, and the patient died seventeen days after operation. Asthoewer points out that in some cases the costal arch is so broad and non-resisting that the osteoplastic operation may be unnecessary. On the other hand, with a narrow costal arch the resection within the limit of the cartilaginous portion of the ribs will not give good access to the dome of the diaphragm. And if we resect the ribs beyond the cartilaginous portion, we run the risk of injuring the diaphragm.

Willy Meyer, in 1906, reported two cases in which he had resorted to an osteoplastic resection of the costal arch.

The first case was that of "a boy 14 years of age who had an absolutely impermeable cicatricial stricture of the œsophagus (caustic lye). For eight years he had been fed entirely through a gastric fistula. All attempts to enter the stomach from above as well as under direct inspection with

the urethral speculum introduced through an œsophageal lip fistula in the neck having failed, an osteoplastic flap was raised by a V-shaped incision, the water-tight gastric fistula being carefully preserved. A part of the anterior wall of the stomach, well above the fistula, was thus reached, horizontally incised, and the passage upward searched for from below. To my great disappointment this attempt, too, proved unsuccessful. The œsophagus was evidently obliterated for some distance. The stomach incision was therefore closed again by means of a double row of Lembert silk sutures; the osteoplastic flap was fitted back in its place and the skin sutured; there was no drainage. The boy made a good recovery."

Willy Meyer's second case was one of multiple sarcoma of spleen. The abdomen was opened through a median incision; to this was added a transverse incision extending to the tip of the eleventh rib. The costal cartilages were exposed by blunt dissection. The seventh cartilage was divided close to its sternal attachment, then the seventh, eighth, ninth and tenth cartilages were divided near their junction with the ribs. This gave such excellent exposure that the large spleen was easily removed. The tumor proved to be a metastatic, small, round-celled sarcoma. The man made an operative recovery, but died suddenly of internal metastases ten weeks after operation. The autopsy showed good union of all the costal cartilages.

The author's case differed in several respects from those previously reported. The osteoplastic resection of the costal arch was done to accomplish a resection of the lesser curvature of the stomach and lower end of the œsophagus. The operation was done in two stages; thirty days elapsed between the osteoplastic resection and the resection of the stomach and œsophagus.

Sarah S., Russian, 45 years old, was admitted to Dr. Lilienthal's service June 28, 1907 and came under the writer's care. Both parents had died of pulmonary disease presumably tubercular. With the exception of measles in childhood, the patient had always been well. She had been married 25 years, had had seven children and no miscarriages. Although she had been complaining of her stomach for ten years, she had only been vomiting for three months prior to her admission. During this time she had been vomiting small quantities almost daily, but only after eating. She had never vomited large quantities but there was frequent eructation of gas. She had often complained of slight pain and uncomfortable sensations in the left epigastric region. Constipation was marked and the patient had lost considerable

flesh. No fever or jaundice had been noted. The chief complaints were vomiting and loss of weight.

Physical examination: General condition good, fairly well nourished. Tongue clean and moist, teeth and gums in poor condition. There were no palpable glands. The heart and lungs were normal, the abdomen adipose, large and flabby. There was no abdominal rigidity but slight tenderness in the epigastrium on deep pressure. No mass was palpable either in the supine or in the knee-chest position. The liver was not enlarged to percussion, nor was it palpable below the free border of the ribs. The spleen was not enlarged. Vaginal examination showed a moderately enlarged uterus. Rectal examination was negative. A test meal showed the presence of lactic acid and the absence of free hydrochloric acid. Dr. G. A. Friedman who referred the case to the hospital deserves the credit of having made the diagnosis of carcinoma of the lesser curvature of the stomach.

Operation July 1, 1907: *Exploratory Caliotomy and Osteoplastic Resection of Chest Wall*. Gas and ether. The abdomen was opened through a four-inch median epigastric incision. A tumor was found involving the lesser curvature of the stomach and the cardia. The tumor was fairly movable, but could not be brought into the field of operation. It could be felt high up under the dome of the diaphragm but it could not be seen. An incision was then made parallel to the free border of the ribs on the left side connecting with the median incision. This incision was made with the view of doing an osteoplastic resection of the chest, as it was impossible to deliver the tumor into the wound or to tie off the gastrohepatic omentum. The seventh, eighth and ninth ribs were exposed by blunt dissection and the cartilages of the seventh and eighth ribs were divided close to the sternum. During this manipulation the pleura was injured and the opening at once closed by suture. There was a striking improvement in the exposure of the tumor. It could now be readily brought into the wound and freed from the gastrohepatic omentum by heavy catgut ligatures. An assistant meanwhile made firm traction on the left chest wall; so that whereas before the division of the costal cartilages no one taking part in the operation was able to see the tumor, we were now able to examine it carefully and study its relations to the surrounding tissues. Owing to the fact that the patient became very cyanotic and the pulse rapid and

feeble, it was deemed advisable to postpone further interference. Two gauze drains were inserted, one anterior and the other posterior to the tumor. The abdomen was closed with through and through silk sutures.

On the following day there was moderate subcutaneous emphysema of the chest wall. A day later the emphysema extended to both infra- and supraclavicular regions and upward on both sides of the neck. It then extended up over the left side of the face. The swelling produced by the emphysema was especially marked in the supraclavicular regions. On pressure the swelling could be very much reduced, but as soon as the pressure was removed, the swelling returned. It was not deemed safe to turn the patient to make a careful examination of the chest, but there were signs of air in the pleural cavity. Temperature, 102.4° F.; pulse, 138; respiration, 38.

On July 7th the emphysema had extended to both sides of the face as far as the orbital regions, so that the facial expression was that of a nephritic. However the patient did not suffer any inconvenience therefrom. She complained a great deal of cough especially at night. The first dressing showed the pleural opening closed and the wound clean. Two weeks after operation there was a moderate pyocyanous infection of the wound. The emphysema had become less marked. The daily vomiting which had been present before operation, persisted. On July 19th the emphysema had disappeared entirely from the left side and only a little remained on the right side in the infraclavicular region. The pyocyanous wound infection was much less marked. Owing to the persistent vomiting it was not possible to improve the general condition, and there was a steady loss of weight. This was of course to be expected as the tumor in the stomach had not yet been removed. We were thus forced to do the secondary operation under unfavorable conditions.

Operation July 31, 1907: *Partial Gastrectomy; Resection of Œsophagus; Gastro-œsophagostomy.* No general anæsthetic was administered. A spinal injection of stovaine was given and eucaine was used locally. The former wound was opened and extended downward 2½ inches. The general abdominal cavity was found well walled off by adhesions. The tumor was found to be in the lesser curvature of the stomach involving the lower end of the œsophagus. Some remaining strands of the gastro-

hepatic omentum were cut through and by means of blunt dissection and scissors the growth was isolated. A large V-shaped piece of the stomach, in the centre of which was the tumor, was excised, together with about $1\frac{1}{4}$ inches of the lower end of the œsophagus. The severed end of the stomach was caught with clamps and the field sponged dry of leaking gastric juice. Before cutting across the œsophagus two guide sutures of silk were passed into its wall to enable the pulling down of the cut end. The large opening in the stomach was closed with considerable difficulty owing to the adhesions from the previous operation. Several layers of Pagenstecher linen thread were used, the first one including all the coats of the stomach except the mucous membrane. After closing the opening completely, a new opening was made in the portion of the stomach nearest the severed end of the œsophagus. Into this small opening the end of the œsophagus was implanted and fastened in place with linen sutures. During the entire procedure the patient was fully conscious and did not complain of pain. She was now given a little water to see if the closure was perfect. Two points of leakage were seen and closed by suture. A packing was inserted down to the anastomosis, and the abdomen partly closed with through and through chromic gut sutures not including the skin. The specimen showed a growth 4 by 6 cm., very hard but showing no ulceration. Dr. Mandlebaum who made sections from the tumor pronounced it adenocarcinoma.

The immediate reaction from the operation was good. Nothing was given by mouth for seven days. Murphy infusion and stimulating enemata were well retained. Pulse and temperature were only slightly above normal during the first week following operation. During this time the wound discharge was very moderate and alkaline in reaction. On the eighth day a little water was given by mouth. The packings had been removed on the sixth day and fresh ones inserted. On the ninth day the patient drank water freely and it was noticed that there was a profuse watery discharge from the wound indicating leakage at the site of suture. On the eleventh day the condition suddenly became worse the pulse going up from 100 to 140 and the temperature from 99.6° to 104.4° F. Respiration became very much embarrassed and cyanosis marked. In spite of active stimulation the patient died eleven days after operation.

Abstract of the Wound Examination by Dr. Libman.—The œsophagus had separated from the stomach by 2 cm., with sloughing at the free end. There was a large subphrenic abscess on the left side. The mediastinum and pleura were normal. There was no evidence of carcinoma, and no enlarged glands. There was fatty degeneration of the liver. The lungs showed passive congestion but no consolidation. A large healed cavity was found at the right apex. All of the stomach sutures had held and the suture line was water-tight.

So few operations of this kind have been done on the human subject that a careful analysis of each case is not only advisable but imperative. The shock of doing the entire operation under anæsthesia at one sitting is very great, and the resulting mortality would be too high. We have a choice of two alternatives, either we can do the operation under anæsthesia in two stages, or we can do one or both stages under spinal anæsthesia. Theoretically there is an objection to doing the operation at two sittings; adhesions that formed between the two steps of the operation might interfere with the secondary resection of the stomach. On the other hand the adhesions will partly wall off the rest of the peritoneal cavity and thus very much lessen the danger of a peritoneal infection. In our case we waited thirty days before doing the secondary operation, and although extensive adhesions had formed, they did not materially complicate the technic; and we had a feeling of security from the fact that the general cavity was partly shut off.

The first step in our operation was done under gas and ether; and the second step of the operation, the resection of stomach and œsophagus, under spinal anæsthesia. It was surprising how well the patient stood this second operation which took one and a half hours. During all this time she was fully conscious and was conversing with the operator and his assistants. At the close of the operation she declared she had had very little pain.

There is another advantage in using spinal anæsthesia. When we have completed our suturing of stomach and œsophagus the patient can be asked to swallow some water, and we can then detect any leak in the suture line. We took advan-

tag of this procedure in our case, and found two small openings in the suture line which were readily closed. And at the wound examination the suture line in the stomach was found water-tight.

A point in the technic of the utmost importance is the method of disposing of the open end of the œsophagus. If we resect an inch and a half or more of the œsophagus its cut end will not be covered by peritoneum. Even though we are able to bring down the œsophagus and suture it into the stomach without tension, the chance of getting a good union is minimized by the absence of peritoneum over the end of the œsophagus. In animal experimentation there is not so much difficulty in getting a good union between stomach and œsophagus. But in the human subject as is well known the success of all anastomoses in the gastro-intestinal tract depends on good union of the serous surfaces. Where the serosa is absent, as in the second portion of the duodenum and the lower portions of the rectum, we are very apt to have leakage. And that is what unfortunately happened in our case. Although we were able to bring down the cut end of the œsophagus and suture it without tension into the newly-made opening of the stomach which was drawn well up under the diaphragm, the sutures did not hold. There was leakage, followed by a sub-phrenic abscess, which caused the death of the patient. On the other hand every single suture employed in the wall of the stomach held securely for eleven days until the patient's death, because here we had good serosa in our suture line.

How else can we deal with the cut end of the œsophagus? We can sew it up completely and do a gastrostomy or a jejunostomy; or we can make an œsophageal fistula at the root of the neck, bringing out the cut end of the œsophagus and suturing it to the skin of the neck. This could, if necessary, be done at a subsequent sitting, thus dividing the operation into two or three steps. Had either of these methods of dealing with the end of the œsophagus been carried out in our case, we believe the patient would have had an excellent chance to re-

cover. So that this point in the technic is really of vital import.

The objection to closing the œsophagus completely is that fluids from the mouth would run down and cause trouble. This objection would be overcome by making an œsophageal fistula in the neck.

We do not wish to claim originality for this step but, so far as we have been able to search the literature, we have nowhere found this suggestion either made or carried out.

The steps of the complete operation, which could be divided into two or three sittings, would then be:

First Operation.—Osteoplastic resection of costal arch, either through an incision parallel to the free border of the ribs, or through a median and cross incision.

Second Operation.—Resection of stomach and œsophagus; and gastrostomy or jejunostomy.

Third Operation.—Æsophagostomy at the root of the neck.

The idea of doing an œsophagostomy instead of attempting to suture the œsophagus to the stomach occurred to the writer from its analogy to doing a colostomy after excision of the rectum. The writer is aware that Sauerbruch, in his animal experimentation, obtained better union between œsophagus and stomach by the button than by suture. His suture cases all leaked. However, we can hardly, in the human subject, expect to get a watertight, permanent union by the button. Indeed, judging from the use of the button in intestinal work, we could not expect as good results as from sutures.

Furthermore, at the present time, when even the question of doing intrathoracic operations under positive or negative pressure is still *sub judice*, the operation which the writer has suggested would seem to have a field of usefulness. And it must also be admitted that intrathoracic operations are much more shocking than intraperitoneal operations. And finally, if we determine not to bring down the œsophagus, we can resect it at a higher level and thus get further away from the diseased focus.

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